

This Listing of Claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (currently amended) An electronically insulating proton conductor (EIPC) of a membrane electrode assembly that ~~is capable of converting~~ converts chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C, wherein the EIPC is supported on an electronically conducting support.

2. (withdrawn) An electronically insulating proton conductor of a membrane electrode assembly that is capable of converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said electronically insulating proton conductor containing no acid-containing liquid phase.

3. (currently amended) A proton conducting composite membrane comprising an electronically insulating proton conductor (EIPC) of a membrane electrode assembly that is ~~capable of converting~~ converts chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C, wherein the EIPC is supported on an electronically conducting support.

4. (withdrawn) A proton conducting composite membrane comprising an electronically insulating proton conductor of a membrane electrode assembly that is capable of converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said electronically insulating proton conductor containing no acid to maintain conductivity.

5. (withdrawn) A membrane electrode assembly comprising an electronically insulating proton conductor and being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C.

6. (withdrawn) A membrane electrode assembly comprising an electronically insulating proton conductor and being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said membrane electrode assembly contains no acid to maintain conductivity.

7. (withdrawn) A membrane electrode assembly comprising a metal hydride support and an electronically insulating proton conductor on said metal hydride support.

8. (withdrawn) The membrane electrode assembly of claim 7, wherein said electronically insulating proton conductor is catalyzed.

9. (withdrawn) A fuel cell comprising an electronically insulating proton conductor, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C.

10. (withdrawn) The fuel cell of claim 9, further comprising a metal hydride.

11. (withdrawn) The fuel cell of claim 9, further comprising a mixed conductor capable of conducting electrons and protons.

12. (withdrawn) The fuel cell of claim 9, wherein the fuel cell is capable of reforming a chemical entity into another chemical entity.

13. (withdrawn) The fuel cell of claim 9, wherein the fuel cell comprises a reforming catalyst.

14. (withdrawn) A fuel cell comprising an electronically insulating proton conductor, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said electronically insulating proton conductor containing no acid to maintain conductivity.

15. (withdrawn) The fuel cell of claim 14, further comprising a metal hydride.

16. (withdrawn) The fuel cell of claim 14, further comprising a mixed conductor capable of conducting electrons and protons.

17. (withdrawn) The fuel cell of claim 14, wherein the fuel cell is capable of reforming a chemical entity into another chemical entity.

18. (withdrawn) A fuel cell comprising electrodes and means, responsive to exposure of at least a chemical entity, for converting chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C.

19. (withdrawn) A fuel cell comprising electrodes and means, responsive to exposure of at least a chemical entity, for converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said electronically insulating proton conductor containing no acid to maintain conductivity.

20. (withdrawn) A system for generating electricity, comprising a fuel reformer and a fuel cell, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 220°C to about 550°C.

21. (withdrawn) The system of claim 20, wherein the fuel reformer is a syngas generator.

22. (withdrawn) The system of claim 20, wherein the fuel reformer comprises a reforming catalyst in the fuel cell and/or an external reformer.

23. (withdrawn) The system of claim 20, further comprising a water gas shift reactor.

24. (withdrawn) The system of claim 23, further comprising an oxidation unit.

25. (withdrawn) A system for generating electricity, comprising a fuel reformer and a membrane electrode assembly comprising an electronically insulating proton conductor, said membrane electrode assembly being capable of converting chemical energy of a reaction into electrical energy at a temperature of about 175°C to about 550°C, said electronically insulating proton conductor containing no acid to maintain conductivity.

26. (withdrawn) The system of claim 25, wherein the fuel reformer is a syngas generator.

27. (withdrawn) The system of claim 25, wherein the fuel reformer comprises a reforming catalyst in a fuel cell and/or an external reformer.

28. (withdrawn) The system of claim 25, wherein the syngas generator is capable of generating hydrogen.

29. (withdrawn) The system of claim 25, further comprising a water gas shift reactor.

30. (withdrawn) The system of claim 29, further comprising an oxidation unit.

31. (currently amended) The electronically insulating proton conductor of claim 1 or 2, wherein the electronically insulating proton conductor is selected from the group consisting of $\text{Ba}_3\text{Ca}_{1.18}\text{Nb}_{1.82}\text{O}_{8.73}\text{-H}_2\text{O}$ (BCN 18); CsH_2PO_4 (CDP); $\text{Sr}[\text{Zr}_{0.9}\text{Y}_{0.1}]\text{O}_{3-\delta}$ (SZYO); polyphosphate composite containing 19.96 wt% NH_4^+ , 29.3 wt% P, 1.51 wt% Si; $\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$ (LSSM); and $\text{BaCe}_{0.9-x}\text{Zr}_x\text{M}_{0.1}\text{O}_{3-\delta}$ where M is Gd or Wd and $x = 0$ to 0.4 (BCZMO).

32. (currently amended) The proton conducting composite membrane of ~~claims~~ claim 3 or 4, further comprising wherein the support comprises a metal hydride substrate support.

33. (currently amended) The proton conducting composite membrane of claim 32, wherein the metal hydride is selected from the group consisting of Pd, a Pd alloy, V/Ni/Ti, V/Ni, V/Ti, PdAg, PdCu, Ti, LaNi_5 , TiFe_2 , and CrV_2 and combinations thereof.

34. (withdrawn) The membrane electrode assembly of claim 5, 6 or 7, further comprising an anode and a cathode.

35. (withdrawn) The membrane electrode assembly of claim 34, wherein the anode and/or the cathode comprises a noble metal and/or a non-noble metal.

36. (withdrawn) The membrane electrode assembly of claim 34, wherein the anode and/or the cathode comprises a layer capable of allowing diffusion of a gas and conduction of electrons.

37. (withdrawn) The membrane electrode assembly of claim 36, wherein the layer is selected from the group consisting of a carbon cloth and a metal cloth.

38. (withdrawn) A method for converting chemical energy of a reaction into electrical energy, comprising exposing an electronically insulating proton conductor to a chemical entity at a temperature of about 220°C to about 550°C, and generating electromotive force (emf) across the electronically insulating proton conductor.

39. (withdrawn) The method of claim 38, further comprising exposing the electronically insulating proton conductor to an oxidant.

40. (withdrawn) The method of claim 38, further comprising producing the chemical entity by reforming another chemical entity.

41. (withdrawn) A method for converting chemical energy of a reaction into electrical energy, comprising exposing an electronically insulating proton conductor to a chemical entity at a temperature of about 175°C to about 550°C, and generating electromotive force (emf) across the electronically insulating proton conductor; wherein said electronically insulating proton conductor contains no acid to maintain conductivity.

42. (withdrawn) The method of claim 41, further comprising exposing the electronically insulating proton conductor to an oxidant.

43. (withdrawn) The method of claim 41, further comprising producing the chemical entity by reforming another chemical entity.

44. (currently amended) An electronically insulating proton conductor (EIPC) of a membrane electrode assembly that ~~is capable of converting~~ converts chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, wherein the EIPC is supported on an electronically conducting support.

45. (withdrawn) An electronically insulating proton conductor of a membrane electrode assembly that is capable of converting chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said electronically insulating proton conductor containing no acid-containing liquid phase.

46. (currently amended) A proton conducting composite membrane comprising an electronically insulating proton conductor (EIPC) of a membrane electrode assembly that is ~~capable of converting~~ converts chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490,

500, 510, 520, 530 and 540, wherein the EIPC is supported on an electronically conducting support.

47. (withdrawn) A proton conducting composite membrane comprising an electronically insulating proton conductor of a membrane electrode assembly that is capable of converting chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said electronically insulating proton conductor containing no acid to maintain conductivity.

48. (withdrawn) A membrane electrode assembly comprising an electronically insulating proton conductor and being capable of converting chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540.

49. (withdrawn) A membrane electrode assembly comprising an electronically insulating proton conductor and being capable of converting chemical energy of a reaction into electrical energy at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410,

420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said membrane electrode assembly contains no acid to maintain conductivity.

50. (withdrawn) A fuel cell comprising an electronically insulating proton conductor, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540.

51. (withdrawn) A fuel cell comprising an electronically insulating proton conductor, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said electronically insulating proton conductor containing no acid to maintain conductivity.

52. (withdrawn) A fuel cell comprising electrodes and means, responsive to exposure of at least a chemical entity, for converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540.

53. (withdrawn) A fuel cell comprising electrodes and means, responsive to exposure of at least a chemical entity, for converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said electronically insulating proton conductor containing no acid to maintain conductivity.

54. (withdrawn) A system for generating electricity, comprising a fuel reformer and a fuel cell, said fuel cell being capable of converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540.

55. (withdrawn) A system for generating electricity, comprising a fuel reformer and a membrane electrode assembly comprising an electronically insulating proton conductor, said membrane electrode assembly being capable of converting chemical energy of a reaction into electrical energy at a temperature of about $X^{\circ}\text{C}$ to about $Y^{\circ}\text{C}$, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540, said electronically insulating proton conductor containing no acid to maintain conductivity.

56. (withdrawn) A method for converting chemical energy of a reaction into electrical energy, comprising exposing an electronically insulating proton conductor to a chemical entity at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540.

57. (withdrawn) A method for converting chemical energy of a reaction into electrical energy, comprising exposing an electronically insulating proton conductor to a chemical entity at a temperature of about X°C to about Y°C, wherein said Y is greater than said X, and said X and said Y are selected from the group consisting of 175, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530 and 540; wherein said electronically insulating proton conductor contains no acid to maintain conductivity.

58. (withdrawn) The membrane electrode assembly of claim 5, 6 or 7, wherein the membrane electrode assembly has an area specific resistance in a range of about 0.01 to about 100 ohm.cm².

59. (withdrawn) The fuel cell of claim 9 or 14, wherein a membrane electrode assembly has an area specific resistance in a range of about 0.01 to about 100 ohm.cm².

60. (withdrawn) The fuel cell of claim 9, wherein a membrane electrode assembly has an area specific resistance of a material having a thickness of about 175 microns and a proton conductivity within the gap of Figure 1.

61. (withdrawn) The fuel cell of claim 14, wherein a membrane electrode assembly has an area specific resistance of a material having a thickness of about 175 microns and a proton conductivity within the gap of Figure 2.

62. (withdrawn) The system of claim 20, wherein the syngas generator is capable of generating hydrogen.

63. (new) The electronically insulating proton conductor of claim 1, wherein the EIPC supported on the support generates a protonic conductivity within the gap of Figure 2.

64. (new) The electronically insulating proton conductor of claim 1, wherein the EIPC supported on the support generates a protonic conductivity of greater than 10^{-3} S/cm.

65. (new) The electronically insulating proton conductor of claim 1, wherein the EIPC has a thickness in a range of greater than zero to about 76 microns.

66. (new) The proton conducting composite membrane of claim 3, wherein the EIPC supported on the support generates a protonic conductivity within the gap of Figure 2.

67. (new) The proton conducting composite membrane of claim 3, wherein the EIPC supported on the support generates a protonic conductivity of greater than 10^{-3} S/cm.

68. (new) The proton conducting composite membrane of claim 3, wherein the EIPC has a thickness in a range of greater than zero to about 76 microns.

69. (new) The electronically insulating proton conductor of claim 1, wherein the electronically insulating proton conductor comprises a non-stoichiometric phase of

$M_zH_y(AO_4)_{(x+y)} \cdot xH_2O$ in which M comprises one or more basic elements or molecules selected from the group Li, Na, K, Rb, Cs, NH_3 , Mg, Ca, Sr, or Ba, and A comprises one or more non-basic elements selected from the group V, Nb, Ta, Cr, Mo, W, P, As, S, or Se, and numbers x, y and z are charge balance.

70. (new) The electronically insulating proton conductor of claim 1, wherein the electronically insulating proton conductor comprises an organic-inorganic hybrid.

71. (new) The electronically insulating proton conductor of claim 1, wherein the electronically insulating proton conductor comprises a material selected from the group consisting of mesoporous zirconium phosphate pyrophosphate, a hydrate of $SnCl_2$, silver iodide tetratungstate, a silica-polyphosphate composite containing ammonium ions, $La_{0.9}Sr_{0.1}Sc_{0.9}Mg_{0.1}O_3$, $BaCe_{0.9-x}Zr_xM_{0.1}O_{3-\delta}$ where M is Gd or Nd and x = 0 to 0.4, and $Sr[Zr_{0.9}Y_{0.1}]O_{3-\delta}$.

72. (new) The proton conducting composite membrane of claim 3, wherein the electronically insulating proton conductor comprises a non-stoichiometric phase of $M_zH_y(AO_4)_{(x+y)} \cdot xH_2O$ in which M comprises one or more basic elements or molecules selected from the group Li, Na, K, Rb, Cs, NH_3 , Mg, Ca, Sr, or Ba, and A comprises one or more non-basic elements selected from the group V, Nb, Ta, Cr, Mo, W, P, As, S, or Se, and numbers x, y and z are charge balance.

73. (new) The proton conducting composite membrane of claim 3, wherein the electronically insulating proton conductor comprises an organic-inorganic hybrid.

74. (new) The proton conducting composite membrane of claim 3, wherein the electronically insulating proton conductor comprises a material selected from the group consisting of mesoporous zirconium phosphate pyrophosphate, a hydrate of SnCl_2 , silver iodide tetratungstate, a silica-polyphosphate composite containing ammonium ions, $\text{La}_{0.9}\text{Sr}_{0.1}\text{Sc}_{0.9}\text{Mg}_{0.1}\text{O}_3$, $\text{BaCe}_{0.9-x}\text{Zr}_x\text{M}_{0.1}\text{O}_{3-\delta}$ where M is Gd or Nd and $x = 0$ to 0.4 , and $\text{Sr}[\text{Zr}_{0.9}\text{Y}_{0.1}]\text{O}_{3-\delta}$.